

Srinivasa Ramanujam

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Srinivasa Ramanujan

A problem! Answer in an instant

Ramanujan is cooking food in his kitchen in London. The aroma of South Indian food reaches Mahalanobis, sitting in the hall. He enjoys it and asks, "Where did you learn this art of cooking? The aroma is tempting."

Ramanujan : "I didn't know cooking. I learnt it after I came here, from a few of my friends"

Mahalanobis : "You didn't learn mathematics too from anybody. You learnt it yourself, right?"

Ramanujan : "Yes. I enjoy mathematics. By the grace of God, I have some knowledge of mathematics. By the by, what are you holding in your hands?"

Mahalanobis : "It is the Strand Magazine. It was lying here. There is an interesting problem here. I solved it."

Ramanujan "A problem? What is it?"

Mahalanobis : "Two British officers live on the same road. A friend of these officers is walking along the road. He sees the number plates on houses. He enters his friend's house. He goes to the house of another friend on the same road. Once again he goes on adding up the house numbers. He goes to another friend's house. He is excited to find that the totals on both the occasions were the same. Now the question. Find the numbers on the houses of those officers. I worked on it and got them."

Ramanujan : "What is the answer?"

Mahalanobis : "The house numbers are 6 and 9.

Because $1+2+3+4+5=15$

$$7+8=15$$

So the houses must have been lined up like this

$$1 + 2 + 3 + 4 + 5 + \boxed{6} + 7 + 8 + \boxed{9}$$

Ramanujan : "The answer need not be only those two numbers. In fact, there are many. Write down a continued fraction"

Mahalanobis : "What! Is it a continued fraction?"

Ramanujan : "Yes it is. Write down"

$$6 - \frac{1}{6 - \frac{1}{6 - \frac{1}{6 - \frac{1}{6 - \frac{1}{\dots}}}}}$$

The convergents give the numbers of the houses of the first British officers. (Convergents are sums of series converging on zero in a few steps)

Mahalanobis : So there are infinite answers to our question. Let us see the continued fraction

$$\text{First convergent } \frac{6}{1}$$

$$\text{Second convergent } 6 - \frac{6}{1} = \frac{35}{6}$$

$$\text{Third convergent } 6 - \frac{1}{6 - \frac{1}{6}} = 6 - \frac{6}{35} = \frac{204}{35}$$

Fourth convergent

$$6 - \frac{1}{6 - \frac{1}{6 - \frac{1}{6}}} = 6 - \frac{1}{6 - \frac{6}{35}} = 6 - \frac{35}{204} = \frac{1189}{204}$$

The numbers 6, 35, 204, 1189 are all numbers of the first officer's houses. This is wonderful.

This episode illustrates the depth of understanding of numbers and the sharp intellectual insights Ramanujan had when confronted with problems.

In the example given above $1 + 2 + 3 + \dots 34 = 595$. If 35 is set aside, $36 + 37 + 38 + \dots 49 = 595$. That means, the number of the second officer's house was 50.

Mahalanobis, conversing with Ramanujan, was no ordinary man. He was a great statistician. He gave a mathematical foundation to our five year plans. He was also the founder of the Indian Statistical Institute.

Ramanujan blazed like a star among the mathematicians of the era. An unknown lad, born in a colonial country like India, becoming the cynosure of all eyes is in itself a thrilling story.

Poverty in Childhood

Ramanujan was born in a traditional family. K. Srinivasa Iyengar, his father, was working as an accountant in a cloth shop. His mother was



"Does the number zero, when divided by itself, yield one?"

Komalathammal. Ramanujan was the eldest son in the family and was born on 22nd December 1887.

He started his studies in Kumbhakonam where his parents lived.

He had an analytical mind. When one of his teachers explained the division of numbers in a class, that a number divided by itself always yields one, Ramanujan stood up and asked, "Does the number zero when divided by itself yield one?"

Ramanujan was a plumpy child, very docile, very decent. He would contradict none. The poverty in the house was biting. Often he had to go hungry. His father used to earn Rs. 20 per month in the cloth shop. Komalathammal ran a mess for two students in the house and earned ten rupees month. But it was difficult to run the house. She would get five rupees extra income, as a participant in a bhajan mandali of Sarangapani Temple. In all, the family did not earn more than fifty rupees. So hunger loomed large in the family. The good nature of Ramanujan was noticed by neighbours. His friend Venkataramana's mother used to send some food to Ramanujan. Many a day that was all the food he had.

He did not have clothes to wear. He had a

dhoti, no shirt. Another dhoti would cover his upper body. This was his dress in all the years he spent in India, till he left for England.

Attracted to Mathematics

The impact of two students visiting Komalathammal's house was immense. They changed Ramanujan's life. The students came to the house for meals. They taught Ramanujan mathematics. They satisfied Ramanujan's inquisitive mind. They appreciated his fast learning and gave the books they had to him.

By 1900 Ramanujan was studying in the third form in Kumbakonam Town High School. By then he was working on series and sequences. He had studied trigonometric functions, even before he knew that they were ratios of the sides of a triangle.

Ramanujan had a special ability. When someone exposed him to a new branch of mathematics he dived deeper into it in a few days and mastered it. He would become an expert. Hence accolades and prizes followed him. He got the first prize in the second form, the second prize in the fourth form, the first prize in the sixth form, etc.

There are no records to show that teachers bestowed any extra interest on this bright pupil. They did not give him extra books to improve his knowledge etc. Perhaps the times were such. Under colonialism a knowledge of English was most preferred. This alone could give star value. And a good job meant only the I.C.S. (Indian Civil Service). Ramanujan's brilliance in mathematics went unnoticed. In later years, too, Ramanujan suffered because of inadequate knowledge of English. (The letters to Prof. Hardy were drafted by others.)

But Ramanujan had a knack of balancing his studies. He was ahead of others in all subjects in the High School. Many a time it is said, he answered questions in a few subjects (not dear to him), humorously. Regarding digestion he wrote "Excuse me, I have written a half-boiled answer."

By 1903 he got hold of an important book called "Synopsis of Pure Mathematics." This was a collection of formulae and identities in mathematics. It also had many theorems and statements, but no proofs. Ramanujan began to construct proofs for all these. This became a hobby. In the Matriculation Examination he took the first rank for the entire

Madras province. So he secured a scholarship and this took care of his fees and books.

In the College

Ramanujan joined the F.A. course. The library of the college lay open to him. He searched for and read mathematics books. He read all the mathematics books in a short time. At the same time other subjects got neglected.

But the college library in Kumbakonam did not have books on higher mathematics. Hence Ramanujan worked out the same problems already solved by Euler, Abel, Bernilli and others. He did not know that these have been already solved. When he came to know this he was miserable.

He failed in all subjects except mathematics in the First Year F.A. examination.

It was a shock to him. For the first time he had failed in an examination. He walked towards a railway station and boarded a train.

His parents began searching for Ramanujan. Not a trace anywhere. They published "Come back" advertisements in news papers, but in vain. Ramanujan returned on his own after a week. He had travelled upto Vishakapatnam. His parents

sympathized with Ramanujan. They thought a change of place would calm him down. They encouraged him to join the Pachhiappa's College in Madras (now Chennai).

But how to meet the expenses at Madras was a moot question. One option was open - to earn by giving tuitions. So Ramanujan made it to Madras. He had to trek long distances to give tuitions. The busy life in the city made him anxious. His health deteriorated. He fell ill. He came back to Kumbakonam.

The result was the loss of a whole year - 1906. He did not have sufficient attendance. He sat for the examination privately. As usual he passed in mathematics, but failed in others.

Intense mental stress, the frustration over not achieving anything, the grief of the parents that every thing had failed - in such a situation his only relief was the visit he occasionally paid to Pachiappa's College. This library had books in German, French and English languages. Ramanujan knew a little English, but not the other two languages. But mathematical symbols posed no obstacle to the study of mathematics books. He began to study them. But there was none to

encourage him. Even then whatever he thought to be good formulae or results, he began to write them down in a note book. At times he tucked his note book under his arm and wandered to find someone who could understand them.

Ramanujan encountered one problem throughout his life. He did not understand how to write a research paper. None of his teachers was capable of teaching this. The book Ramanujan read "Synopsis of Pure Mathematics" had compilation of formulae and statements of theorems without proofs. He followed this pattern and did not bother to codify the logical steps to reach the formulae. He had no idea of this discipline.

Marriage

He got over the depression but did not go beyond the F.A. examination. His mother felt that he would learn responsibility if he had a family of his own. She found a girl named Janaki aged nine for a bride and married her to Ramanujan.

Janaki came to her husband's house after a few months. But Komalathammal did not treat her properly. She was forced to do hard work. She was to bring drinking water from a distant place. She had

to do all the chores in the house. When Ramanujan took his wife to Chennai the harassment from Komalathammal did not stop. Ramanujan became further depressed. He could not bear to see the suffering of his wife.

Who Needs my Mathematics?

Sheshu Iyer who taught Ramanujan at Kumbhakonam, had been transferred to Chennai. Iyer had contacts with good mathematics teachers and mathematicians. He called Ramanujan and said, "No one in this country can follow your mathematics. Write to Mathematicians in Cambridge or Oxford or to Mr. Saldana of Bombay University." Another teacher of Ramanujan T. K. Venkatarama Iyer had said "Throw away all your mathematics. A sequence of symbols as you have written is not Mathematics."

It is true that Ramanujan did not receive any accolades or encouragement from any of his teachers. But as soon as he went to London, every one claimed to have discovered Ramanujan.

Ramanujan found that an institution "Indian Mathematical Society" existed. He wrote to the institution. They replied immediately. They refused

to publish his results unless he deduced them with step by step development. Ramanujan did not know how to write his results into a paper. He corresponded with IMS for sometime. He sent some interesting problems which were published in their quarterly in 1911.

An Encounter that Changed His Life

To earn a living Ramanujan had left Kumbhakonam and come to Chennai. He hoped to earn by giving tuitions. Also, only in a city like Chennai he could find someone who could appreciate his mathematics.

So in 1910 Ramanujan came to Chennai. He stayed in K. S. Vishwanath Sastry's room. This person was the son of Ramanujan's teacher Shivakumara Sastry. He wanted to find job and to show his note books to competent persons.

Accidentally he met his childhood friend C. V. Rajagopalachary in a street corner. Ramanujan explained his predicament to him. Rajagopalachary was saddened. He gave some money to his friend and requested him to stay in the hostel room for a few days. He had some plan in mind.

Diwan Bahadur Ramachandra Rao was the

Collector of Nellore. He was a mathematics enthusiast. He had collected like-minded civil servants and started an Analytical Club. After a few years this got transformed into the Indian Mathematical Society.

C. V. Rajagopalachary took Ramanujan to Diwan Ramachandra Rao.

The Collector Rao encouraged Ramanujan. He promised to send a hundred and fifty rupees every month if Ramanujan would continue his research in mathematics.

Ramanujan got elated. For the time being he could maintain himself and his family. He brought his wife and started a family in a small rented house in Madras.

Ramachandra Rao was prompt in sending money every month. Ramanujan had to report to him his research every month. But Rao did not know modern mathematics. Hence Ramanujan had to remodel his results so that his mentor could appreciate his work. During this period (1911-12) he contributed articles regularly to the Journal of Indian Institute of Mathematics.

But he knew he could not depend upon the

largesse of Ramachandra Rao for long. He was in search of other support.

A Clerk in Port Chennai

Sheshu Iyer was Ramanujan's teacher in Kumbakonam. He met him once. The teacher helped Ramanujan to get a job in the Chennai Port. He had to keep records of goods loaded and unloaded.

Ramanujan immediately wrote to Rao and thanked him profusely for his help. Ramachandra Rao wrote a letter in praise of Ramanujan to San Francis Spring, the president of the Port Trust.

This resulted in the manager of Port Trust, Narayana Iyer being called to Spring's office, and both planned to introduce Ramanujan to professors in Cambridge University. But Ramanujan did not know enough English, so Narayana Iyer drafted the letter.

In the letter written to Professor Hardy Ramanujan wrote with all humility, "I am working as a clerk in Madras Port Trust on an annual salary of 20 pounds... I beg to state that I had no university education but I have undergone the ordinary school course... I have made a special study of divergent series." He enclosed a list of 120 theorems and formulae.

Hardy's Mail of the Day

Cambridge was famous for its faculty in the Mathematics Department. It was here the great mathematician Newton had studied. He was a tutor in Trinity College. Among the branches of Mathematics, Pure Mathematics is considered very abstract and difficult to comprehend. In this branch, the fundamental nature of numbers is analyzed, the relationship between different types of numbers explored. Everyone is aware of even / odd numbers. Like this there are divisible numbers and indivisible numbers. Is there a relationship between sequence of indivisible (prime) numbers? If so what logic leads to it? Questions like this are explored in pure mathematics.

That is why this branch is considered a dry subject. The researches are not related to the day to day life of people. Prof. Hardy had written a book called "A Mathematician's Apology". Only geniuses can enter and make a mark in Pure Mathematics. Pure Mathematics tests the depth of a mathematician's abilities.

In Pure Mathematics Prof. Hardy was a star of the times. There was a bunch of greats along with him in the department.

To such a genius as Prof. Hardy, Ramanujan had written this letter. He had listed 120 theorems and formulae as his own discoveries. Prof. Hardy was screening the day's letters. He has recorded the incident as follows: "In the list Ramanujan had sent, the formulae no 10 and 12 captured me. I had never seen such formulae before. The man who can construct such formulae must be a first rate mathematician, I thought"

That was Ramanujan's impact. We can only guess the intellectual heights he had climbed.

Hardy's Plan and Solace

The surprised Hardy fixed a meeting with Prof. Littlewood the same evening, to discuss the letter. Both analyzed the strengths and weaknesses of Ramanujan. His ignorance in certain areas was glaring. They correctly guessed that in a backward country like India, with no facilities for exchange of ideas, Ramanujan could hardly be aware of modern developments in mathematics. But they appreciated his genius. They realized that Ramanujan would never receive the guidance needed for research and that, without contact with new development in his field, Ramanujan's brilliant intellect would wither away.

Contrary to this, Europe had a lively atmosphere of Mathematics. Two hundred years of continuous activity had enriched all the branches of Mathematics. Ramanujan's mathematics was all self-taught; he could continue to rediscover and learn mathematics all by himself. But it would be time-consuming. But if he could get exposed to European Mathematics, Ramanujan could grow further. This was the reasoning of Prof. Hardy. So he planned to get Ramanujan somehow to Cambridge.

In the meanwhile, on 8-12-1913, Prof. Hardy sent a cordial and soothing letter in reply. He tried to boost Ramanujan's confidence and recorded his praise for his work. He had also pointed out the mistakes he had committed due to lack of the right inputs. He had stressed that instead of listing formulae it was better to prove them and try to explain the logic involved. He had stated, "Prof. H. A. Neville is visiting Madras for summer lectures, and you will get good advice from him."

Throughout the letter Ramanujan was praised for his work; it was also hinted that his knowledge was inadequate.

Prof. Hardy indicated that if Ramanujan could

continue research on prime numbers that would be a lasting contribution to Mathematics.

Ramanujan Satisfied

Narayan Iyer and Ramanujan were elated to receive Prof. Hardy's reply. They wrote back answering Hardy's queries "I have found a friend in you who views my labours sympathetically... I find in many a place in your letter rigorous proofs are required and you ask me to communicate the methods of the proof The sum of an infinite number of terms of the series $1 + 2 + 3 + \dots = -1/12$ according to my theory. If I tell you so you will at once point out to me the way to the lunatic asylum.... What I can tell you this. Verify the results I give and if they agree with your results you should at least grant there may be some substance in my work."

Hardy was again and again pressing Ramanujan to explain his results with logical working steps. This was necessary to publish research papers in Ramanujan's name.

But Ramanujan never understood the urgency and necessity of the same.

He felt that his approach to mathematics was

quite different from those of European mathematicians. Hardy might be interested in “well designed” formulae only, he thought. He had hoped that it was enough if Hardy published the same in journals, so that he could get some money, to tide over his difficulties.

In the early letters Prof. Hardy could gauge the predicament of Ramanujan. But Ramanujan had to come to England to get exposure to research work. This was the reasoning of Prof. Hardy.

So he remembered Prof. Neville’s visit to Madras under the Universities Scholars’ Exchange Programme. Prof. Neville would be delivering lectures at Madras University. Prof. Hardy requested Prof. Neville to meet Ramanujan and persuade him to come to England.

Meeting with Prof. Neville

Ramanujan tucked his notebooks under his arm and visited Madras University. It was the first week of January 1914. Prof. Neville was lecturing in the Senate Hall. Soon after the lecture he rushed to the waiting Ramanujan.

After exchanging pleasantries, Prof. Neville conveyed the queries of Hardy to Ramanujan.

Ramanujan immediately spread out his notebooks on the table. Without airs and in a natural manner Ramanujan began his explanations. Prof. Neville was convinced of Ramanujan’s originality and brilliance. “You can carry these results if you desire,” Ramanujan offered. Prof. Neville was taken aback. He saw the utter simplicity of Ramanujan, and was speechless.

After a few meetings and discussions Prof. Neville broached the subject of Ramanujan’s visit to England.

Narayana Iyer was instantly happy. But not Ramanujan. He was afraid of the caste restrictions. As a Brahmin he could not cross the seas. He might be denied happy worlds after death.

Neville kept Hardy informed of what was happening in Madras. He also conveyed the negative answer of Ramanujan. But Hardy pressed Neville to try again. Only then Neville began to coax Ramanujan’s friends to make him agree.

First Researcher

Dewan Ramachandra Rao had high contacts in Madras. Through him many influential people came to know about Ramanujan. They began to help him.



Ramanujan met Prof. Neville

They wrote letters to the Vice-Chancellor, the Registrar of Madras University, and the head of the Port Trust, Sir Francis Spring.

All this pressure worked. Madras University sanctioned a seventy-five rupee scholarship to Ramanujan.

Ramanujan got relieved. He felt like one holding a floating log after a shipwreck. He was also worried that his mathematics may not be appreciated by the people helping him.

Anyway Ramanujan was the first researcher of Madras University in the Mathematics Department. He shifted his house to Hanumantharaya Koil Street. He felt more secure.

Reluctance to Go to England

Ramanujan had an orthodox background. Orthodoxy barred anyone crossing the seas. He was afraid to break this rule. His mother, too, did not give consent. He would lose his Brahmin caste, she thought. Hence Ramanujan firmly refused to go to London.

Dewan Ramachandra Rao felt shocked. He wrote to his friend Narayan Iyer to devise a plan to convince Ramanujan's mother. Ramanujan's family

were devotees of the deity Namagiri at Namakkal, so Narayan Iyer asked Ramanujan's mother "If Namagiri permits will you give consent to Ramanujan's journey?" She agreed. Iyer got her to promise this, with a vow.

Narayan Iyer, Ramanujan and the Iyer family went to Namakkal and participated in the worship for three days. On the last day Ramanujan dreamt that the goddess had asked him to go to England.

Immediately Prof. Neville arranged funds for the travel. He also made provision for Ramanujan's family. Ramanujan's friends also joined hands.

Preparation to Go to England

A dark obese body. No shirt covered the shoulders. He would cover them with a dhoti, with long hair tied into a knot at the back. Three long white marks on the forehead. What if such a figure should be roaming in the streets of England? Ramanujan's friends decided literally to give him a face lift.

The knotted hair went away. Cropped hair covered his head; now a shirt, a coat, pants, socks, shoes — all these decorated Ramanujan. Buttoning the shirt, tying the shoe lace, tying the tieknot, all

these proved difficult skills to master. The tie knot eluded him to the end. Wearing western dress, the use of spoon and fork - all this he learnt from his well-wishers.

He got transformed both in dress and eating habits, but at a great cost. He was mentally in a state of shock.

Why did he undergo such trials? Because it was Goddess Namagiri who had ordered him to go to England. He could not go against her orders.

Binny and Carnatic Mills of Madras provided a second class ticket of four hundred and forty rupees to Ramanujan to go to England.

Gracious British Fans

Because of the contacts that Ramachandra Rao had, some British officers in the government came to know about Ramanujan. Every one of them wanted to help in one way or the other. Mr. Griffith was advising Ramanujan, whom to meet at London. He wrote on behalf of Ramanujan to important senior officers in the government. Mr. Gilbert Walker met Ramanujan and examined his note books and later helped him to get a scholarship. Sir Francis Spring contacted the

Governor of Madras. Prof. Nevelle and Prof. Hardy helped Ramanujan at each step.

A question may arise. In a colonial set up how was it possible? There were many Good Samaritans and officers who encouraged learning.

We may also ask, whether a Ramanujan gets the same help in today's set up.

Ramanujan was happy when he boarded the ship to England on 17th March 1914, but he was also anxious. He was heartily welcomed by Prof. Nevelle and his brother at the harbour; they took him home. After a day or two all left for Cambridge. At Cambridge also Ramanujan was put up with Prof. Nevelle. Ramanujan joined Trinity College. Prof. Hardy paid 20 pounds as fee and arranged a scholarship of 40 pounds on the first day. Ramanujan was filled with wonder. The help extended and the warmth of the friendship shown to him by both Hardy and Nevelle was a new experience to him.

Hardy waited to seek some clarifications from Ramanujan.

Ramanujan lacked normal, disciplined mathematical training. He had read all and sundry

books on mathematics and absorbed whatever he could. He had a tremendous grasp and a powerful intuition. He would wait to find an iota of logic in a mathematical argument, and instantly could write many formulae himself connected with it. Many times he himself could not make out how he did it. When he was asked how he could proceed at such a tremendous speed he would reply that it was the grace of Goddess Namagiriyanamma. He could never make out the steps from one formula to another, but always believed them to be correct.

Hardy guessed that Ramanujan would not like the regimen of a classroom. It could affect his creativity, he thought. So Ramanujan was permitted to attend the classes he liked. He was told that he was free to work on any area of mathematics.

The daily routine for Ramanujan was this. He would meet Hardy everyday in the mornings. Hardy would draw the attention of Ramanujan to any one of the formulae in his note books and discuss it. Ramanujan would think about the problem and would write the formulae and connected results. He would continue to work in his dormitory also. He would submit all that he had done to Prof. Hardy, the



Prof. Hardy welcomed Ramanujan

next day. Hardy would pass them on to Prof. Littlewood. Once a week Prof. Littlewood visited Ramanujan in his hostel and discussed those formulae. He would point out the mistakes which Ramanujan got corrected.

There were many areas where Ramanujan was ignorant. But he was at ease with geometry, trigonometry and calculus. He was an expert in making out sums of series and sequences. He would write continued fractions for any number approximating to any value.

Ramanujan did not go to Cambridge as a student to learn. He went as a researcher, to discover new things. Soon after he went to Cambridge, a mathematics Professor, Prof. Berry, once wrote some new theorems on the black board. Ramanujan was in the class. The professor turned to him and said, "Have you noted what I have written? Would you like to add anything?" Ramanujan went up to the board and wrote some new theorems which Prof. Berry had not yet reached. The professor was amazed.

It was not long before Ramanujana's fame spread in Cambridge.

Life in England

Trinity college of Cambridge University had a hostel on the campus. Ramanujan was given a room in it. The library was just a few paces away. There was no vegetarian hotel near by. Ramanujan refused to eat in the college hostel. He learnt to cook. He brought vegetarian items on his visit to London and experimented with cooking. He wrote back home to get some spices and other ingredients Ramanujan became an expert cook in a few months. Often he would entertain his friends and their families.

Soon this enthusiasm faded. As new subjects were taken up, Ramanujan became aware of his ignorance. He devoured mathematics day and night. The news from India about his family was depressing. His wife was being harassed by his mother. He neglected food and sleep.

Soon Ramanujan lost his friends and admirers. They could not understand the swings in his moods and his mathematics. His interactions with friends stopped. The pressure of work and anxiety increased.

Ramanujan lost interest in day to day chores. Once Mahalanobis visited him in his room and

asked how he had slept the previous night "It was so cold the whole night. I wrapped a newspaper around my head and spent the night," replied Ramanujan. Mahalanobis peeped into his bedroom. The rug and the bed sheet were neatly spread on the bed. Ramanujan had slept on them. He did not know he had to cover himself with them.

Research in England

Ramanujan had informed his friends in his letters that he did present a few of his results at the London Mathematical Society. But the presentations were actually made by Prof. Hardy. Hardy recorded the results of Ramanujan's research in his lectures. Why was it so? Because Ramanujan did not know how to present a research paper. The elements of a paper to be presented, like the introduction, the explanation of the problem, determining the approach to the solution and a step-by-step solution- this kind of presentation Ramanujan did not know.

Hence the helping hand of Prof. Hardy was necessary. Here we have to record the intellectual honesty of Prof. Hardy. None would have objected if Prof. Hardy had presented the results of Ramanujan's work as his own. As Ramanujan was

incapable of presenting them in such a way that others could understand, he, too, would not have objected. In fact Ramanujan had thrown open all his note books to be used as he pleased, before Prof. Hardy. This was a challenge to Hardy's honesty. Never did he claim anything of Ramanujan's work as his own. It was Prof. Hardy who rendered full justice to the mathematics work of Ramanujan.

Hardy recommended to the Trinity College to award the BA degree to Ramanujan based only on his research. This was in March 1916. All the results Ramanujan obtained were corrected, polished and made presentable by Hardy and Littlewood. They were published by the London Mathematical Society, the Cambridge Philosophical Society and other research / academic bodies.

'Partition Theory' (grouping numbers to yield same summation in different types), Elliptical Functions (an algebraic function) and Continued Fractions were fields of study chosen by Ramanujan. Mathematicians of Europe began to recognize Ramanujan. They began to look to him for something new each month.

Ramanujan was honoured as a Fellow of Trinity College in 1917. On 28th February 1918 he was

elected as a Fellow of the Royal Society. This was a very great honour. As soon as he got it the Indian press began to eulogise him. Everyone began to heap praises on Ramanujan. This included those who did not know anything about mathematics or what Ramanujan was doing. It was significant to them that an Indian stood intellectually equal to the British who were ruling the country. It prompted Indian students studying in Britain, to search for and befriend Ramanujan. That is how Mahalanobis met him.

Once he was awarded the FRS, Ramanujan felt an overwhelming sense of gratitude. He threw himself heart and soul into his research pursuits. He studied many branches of mathematics with the help of Hardy and Littlewood. Hence many new areas were opened up for exploration.

But food and sleep suffered. Since he was alone in his room and cooked food for himself, this was the first casualty of his loneliness. He neglected cooking. He starved. His weight went down.

Soon tuberculosis, a dreaded disease of those days, attacked him. Ramanujan's friends admitted him to a nursing home at Wales (a town nearby). This did not suit him. Later they shifted him to Matlock House Sanatorium in Derbyshire town.

Ramanujan's negligence and stubbornness took their toll. He did not take sufficient rest. He lied about taking the prescribed medicines. He engaged himself in continuous work.

Hardy intervened. Ramanujan was admitted to a sanatorium at London. The nurses at the new sanatorium were strict. He received good care. His health showed signs of recovery.

Hardy rescued Ramanujan both as a benefactor and a friend.

Mental Depression

Hardy noticed that Ramanujan had stopped writing to his family. He wrote to Subramaniam at Chennai. The reasons came to be known slowly. Ramanujan's wife could not tolerate the harassment of her mother-in-law. She had returned to her parents. Komalathammal had treated Janaki like a slave. She was asked to do all the chores. She had to bring drinking water from a distance of a few miles. Ramanujan would enquire about Janaki in his letter. But Komalathammal would never let her know of the concern of her husband. Once Janaki wrote a small letter to her husband and inserted the same in the cover meant to be posted to Ramanujan. But

Komalathammal on getting to know about it tore it off. Though Ramanujan came to know about it through other acquaintances, he did not protest. He had too much respect for his mother. He was depressed.

But he stopped writing letters to his family. He became a victim of depression.

Once he went to London, under this spell of depression. They were war years. The streets were filled with people. Ramanujan entered a restaurant being thirsty and hungry. He enquired whether there was any vegetarian food available. The waiter recommended ovaltine. After drinking the ovaltine, he went to the cash counter to pay the bill. The ovaltine container was on the table and Ramanujan read what was printed on it. He was shocked to find that ovaltine contained egg powder as an ingredient. He was distraught, as if he had committed a grave sin. Just then sirens blared, warning people of an air raid. Everyone began to run for cover to air shelters, built for the purpose. Ramanujan had to spend the whole night in the shelter.

He thought that God had punished him for consuming nonvegetarian stuff. He narrated the incident to his friends.

Thus, the intellectually brilliant Ramanujan was under very severe mental strain but had no companions. There was no one to advise him against his inappropriate behaviour. In this state of depression, one day the thought of suicide occurred to him.

One day he jumped on the rails of a speeding electric train. He was saved by chance that day. The vigilant train driver applied the brakes in time. But the police took Ramanujan into custody for causing obstruction to train traffic.

During the enquiry Ramanujan mentioned his only contact, Prof. Hardy. Hardy's name was recognized by a Police Inspector on duty. Hardy was contacted. As a true friend in need Hardy convinced the inspector that there was a rule that an FRCS scholar should not be arrested.

The police let Ramanujan go But Hardy had lied to the police. No such rule existed. But his concern for Ramanujan's mental health had prompted him to act in this way.

Years later the Police Inspector accidentally met Prof. Hardy and reminded him of this incident. He said that he knew that it was a lie that Hardy told

about the rule. But he guessed that Prof. Hardy did not want the young genius to be hurt and, therefore, was misleading him. So he let Ramanujan go.

This incident convinced Hardy that Ramanujan was mentally ill and he needed treatment. He thought reunion with his family would improve his health. Ramanujan boarded the ship, the Nagoya, to return to India.

Ramanujan received a rousing reception at Bombay and Madras. This amused him and elated him, too.

Ramanujan's friends were taken aback to see him. It was just a bare frame of bones standing before them. They had seen a stout Ramanujan when he departed to England. But Ramanujan retained the glow in his eyes and an astounding memory about friends and wellwishers.

Many philanthropists, British officers and friends helped Ramanujan. A government doctor was appointed to monitor his health. Numperumal Chettiar offered his own bungalow for Ramanujan's treatment and nursing.

But the climate was against him. He shifted from Madras, to Coimbatore, Kumbakonam and

again to Madras. All these troubles had a silver lining. His wife Janaki was with him throughout. Ramanujan's friends ensured that Komalathammal stayed away to leave the couple in peace. Then Janaki was hardly 20 years old.

Smt. Janaki remembers that Ramanujan was always poring over mathematics problems even in those days of treatment and rest. He had to be forced on many occasions.

Ramanujan was working on a slate in his student days. This habit continued to his adulthood. On returning to India he took to the slate again. He would work on the slate and the final results which he thought important were recorded in a note book. During these days he discovered the Mock Theta Function. He conveyed his researches to his mentor Hardy, but did not write about his health.

Some writers regard this period as the most productive phase in Ramanujan's life. The results he put out in these two years are sufficient for future mathematicians to work on for two centuries.

A great mathematician of the age, Prof. Askey, wrote about Ramanujan's work in his last days, when he was very ill, "Two-thirds of the pages deal

with hypergeometric deeper than Ramanujan's earlier work on the same subject. Try to imagine the quality of Ramanujan's mind; it drove him to work unceasingly while deathly ill, it was great enough to grow deeper while his body became weaker. I stand in awe of his accomplishments, understanding is beyond me."

None of the mathematicians who were in India in those days met Ramanujan. None of the professors in any Indian University found it necessary to meet Ramanujan.

Ramanujan breathed his last on 26th April 1920 in his 32nd year. Smt. Janaki was by his side, at Namperumal Chettiar's bungalow. No other member was present in the house. Janaki informed the death to the gardener working in the bungalow.

The news was conveyed to Rajagopalachary. He in turn got together a few Srivaishnavas and conducted the obsequies.

Ramanujan's wife, brother, mother, Rajagopalachary and Namperumal Chettiar were the only persons present at the funeral.

Life and Personality

Ramanujan never enjoyed worldly life. Born in

a poor family, he enjoyed mathematics and also enjoyed a good meal.

He was a compassionate person. He was highly devoted to his mother and the family deity. He had a pleasant disposition. He grew up without telling a lie, an innocent looking boy. It is a miracle that he shot to world-wide fame. He did not have good education, or guidance from anybody. But he made a lasting contribution to the world of mathematics. This is amazing. Hardy reminisced "Ramanujan's genius was equal to that Jacobi Euler and Language."

All these were blazing stars in mathematics. Hardy felt lucky to have had the opportunity of working with Ramanujan. He gave one hundred points to Ramanujan, while ranking mathematicians.

Prof. Hardy compiled the manuscripts of researches of Ramanujan and published them later.

Madras University purchased manuscripts of Ramanujan from Janaki Ammal. For this she received a monthly pension. These manuscript were workings of Ramanujan in the last two years of his life. But no one understood them in India.

Sheshu Iyer and Hardy did publish "The

Collected Papers of Ramanujan". But that did not include his last research work.

Hardy retired from Cambridge in 1940. The alumni of Cambridge requested him to deliver a series of lectures to mark the occasion. Hardy chose Ramanujan's mathematics as dear to him. He gave twelve lectures which were published in Cambridge under the title "Ramanujan : Twelve Talks Suggested by his Life and Works".

Based on this book, one Mr. S. V. Ramamurthy, a retired ICS officer, has written a book, "Ramanujan Memorial Lectures - Thoughts and Things". This book also contains reminiscences of Ramanujan's contemporaries.

No one took up a project to record for posterity, all the material available with Ramanujan's friends, well wishers and others.

The available material shows an innocent Ramanujan, his being deprived of opportunities in India and his being recognized by the West.

Ramanujan's wife Janakiammal was an illiterate housewife like hundreds of women in India. Her greatest goal in life was to serve her husband and in-laws. Her husband's fame made her happy.

But she was widowed at the young age of 20. She could not stay in her in-laws' house and went to her brother at Karachi. She supported herself by tailoring clothes and died at the ripe age of 93 years.

Ramanujan's Lost Note Book

Ramanujan was immersed in mathematics till his last day. He had written down about a hundred pages of formulae. It was this bunch purchased by Madras University, which was sent to Oxford.

This bunch of papers got lost. For many years it was not known to have existed at all. Prof. G. E. Andrews called it "The Lost Note Book of Ramanujan."

When Prof. Watson's library was donated by his family to Trinity College, this lost note book was traced. But it had 32 pages only.

G. E. Andrews has published these 32 pages in facsimile.

The Tata Institute of Fundamental Research in Bombay has printed all the note books of Ramanujan, as facsimile.

In 1987, sixty-seven years after Ramanujan's death, Prof. Berndt brought out two volumes based on this note book. He had studied Ramanujan's note

book for ten years. He wrote, "I still don't understand it at all. I may be able to prove it, but I don't know where it comes from and where it fits into the rest of mathematics."

Ramanujan's published papers are not available now. None of the Universities in India has attempted to publish them.

But Prism Publishing House in Bangalore has filled this gap. It has published "The Selected Papers of Ramanujan."

How Our Country Honoured Ramanujan

Ramanujan brought honour to his country. The saga of his achievement in colonial India became an inspiring story. Ramanujan was one of those who instilled in Indians the confidence that they were second to none.

The government has not started any institution to perpetuate his memory. In his birth centenary year (1987) a commemorative stamp was issued but nothing more was done.

Even today there is no institution in the country where Ramanujan's Mathematics is taught; there is not a single chapter in college / school mathematics texts about Ramanujan.

1729 — A Story

Ramanujan's story is always linked to an episode about a number 1729. As it is made out, it was not an extempore or instant reply given by Ramanujan. He knew about it even before he landed in Britain.

When Ramanujan was being treated for tuberculosis at a place called Putnam, Hardy visited him. Hardy wanted to divert the attention of a depressed Ramanujan. He said "I have come by a taxi. It had a number 1729. This number is not significant, is it?"

Ramanujan replied "Mr. Hardy, It is the smallest natural number which can be written as the sum of two cubes in two different ways."

This means $1729 = 12^3 + 1^3 = 10^3 + 9^3$

The next such number is $4104 = 2^3 + 16^3 = 9^3 + 15^3$

Ramanujan has discovered many such relationships in summation of numbers raised to equal powers.

Ramanujan's Slate

A friend of Ramanujan met him on the Merina Beach. He said "Ramanujan, everyone says you are a genius."



Ramanujan would wipe the slate with his elbow

Ramanujan "Am I? Look at my arms" Both elbows of Ramanujan had turned hard and had bruises. "I don't have paper to write, I work on my old slate. I don't have a duster, too. I use my elbows to rub the slate clean."

In all photographs of Ramanujan we see his arms fully covered. The reason could be this. Also it suggests why he wrote only the final results and formulae, and no intermediary steps.

This slate still exists. S. Narayana Iyer was the Manager at the Madras Port. He requested Ramanujan to give the slate to him.

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